SFA Overview and Approach

Sustainable Systems
Scientific Focus Area

Overview

Complicating the DOE cleanup effort is the complexity of the subsurface system, where natural variability in hydrological, microbiological, and geochemical properties exist over a hierarchy of length scales. The heterogeneity and coupled nature of controlling processes influence the distribution of contaminant plumes and their responses to remediation treatments.

Research within LBNL's Sustainable Systems Science Focus Area is aimed at tackling three important subsurface challenges that currently inhibit a predictive understanding of subsurface flow and transport relevant to environmental stewardship. The 'systems' term emphasizes the SFA characteristic of exploring hypothesis that link fundamental hydrological, biological, and geochemical processes with integrated system behavior from the molecular to the plume scales. The 'sustainable' term recognizes that to be effective over stewardship timeframes, we must consider subsurface strategies that are compatible with prevailing environmental conditions.

Approach and Crosscutting Themes

A common investigative approach and crosscutting themes facilitate fertilization across the three challenges of the Sustainable Systems SFA. LBNL expertise in environmental microbiology, geophysics, geochemistry, and hydrology is jointly used to tackle challenges through integrated experiments, observations, and modeling. Reactive transport modeling provides a framework for iterating between laboratory and field-scale experimentation/observation, and allowing for the transfer of parameters, concepts, and processes across scales. Crosscutting themes include multi-disciplinarity, scale transitions, integrated behavior, and complexity.

Sustainable Systems SFA

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For more information, please visit our website
http://esd.lbl.gov/research/projects/sustainable_systems/

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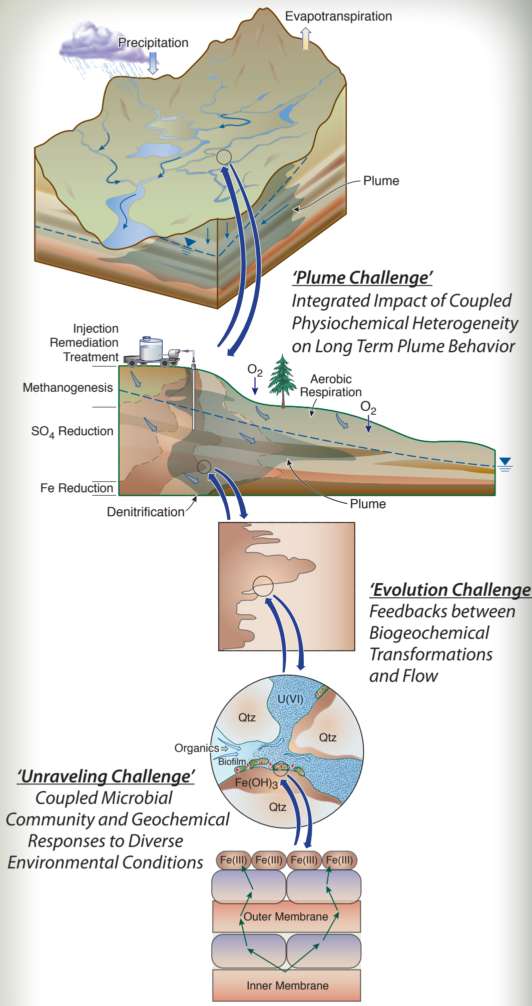
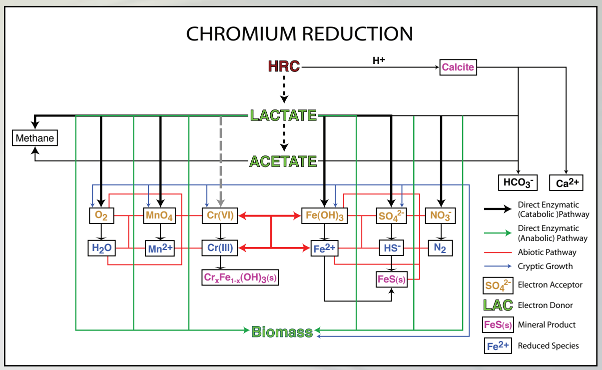


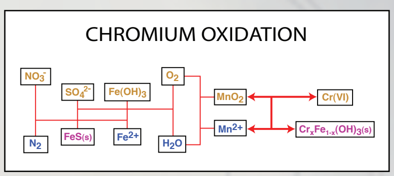
Improving the predictive understanding of subsurface flow and transport relevant to metal and radionuclide contamination through tackling three key challenges.

Unraveling Biogeochemical Pathways Challenge

Objective

The objective of this challenge is to identify and quantify critical and interrelated microbial metabolic and geochemical mechanisms associated with chromium in situ reductive immobilization and reoxidation from the molecular to the local field scales. Beyond specific application to the chromium contaminated Hanford 100 Site, this challenge focuses on developing tools and approaches that can be generally used to "unravel" (deconvolute) complex biogeochemical reaction networks.

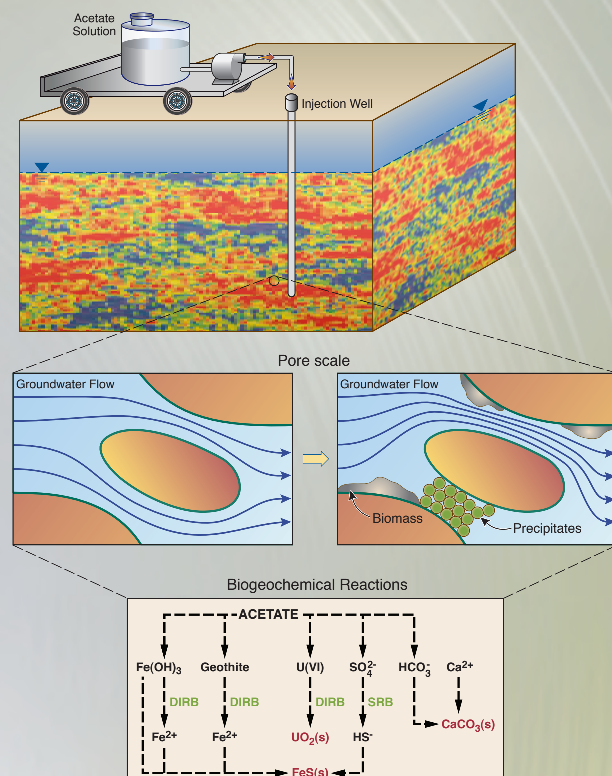




Evolution of Pore Structures and Flowpath Challenge

Objective

This challenge explores feedbacks between remediation induced biogeochemical transformations and flow characteristics by quantifying reaction induced dynamic porosity-permeability relationships in the subsurface, assessing their impact on elemental fluxes and contaminant mobility, and identifying key variables and proxy signatures that are diagnostic of systems-level transitions and feedbacks. This challenge is being explored at the uranium contaminated Rifle, Colorado site in collaboration with the IFRC team.



Predicting Mobility at Plume Scale Challenge

Objective

The objective of this challenge is to test the value of a "reactive facies" concept for parameterizing reliable predictive models of the fate and transport of contaminants at the plume scale and over site stewardship time frames. Reactive facies implies that specific subsurface units display similar characteristics that influence flow and reactive transport. This challenge is being explored at the uranium and iodine contaminated Savannah River Site F-Area in collaboration with the EM Monitored Natural Attenuation Working Group and ASCEM.